

## CLAIMS

1. A method of controlling an assembly line, comprising the steps of:

- 5                   - providing an article assembly line;
- designating, on the assembly line, an upstream processing station and a downstream processing station;
- 10               - delivering a first article to the upstream processing station;
- monitoring an upstream processing function on the first article within the upstream processing station;
- 15               - and if, the upstream processing function in the upstream processing station on the first article is not complete:
  - issuing a signal to an operator in the upstream processing station that the upstream processing function on the first article is not complete;
  - 20               - extending the length of the upstream processing station to allow the upstream operator more time to complete the upstream processing function;
  - monitoring the upstream processing function in the extended upstream processing station;
  - 25               - and if the upstream processing function on the first article is not complete;

- associating a label with the first article for downstream remedial attention;

- advancing the first article downstream from the extended upstream processing station;

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- advancing a second article to the upstream processing station for the upstream processing function;

- and if the upstream processing function on the first article is complete;

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- advancing the first article downstream from the upstream processing station or the extended upstream processing station;

- advancing a second article to the upstream processing station.

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2. A method as defined in claim 1 wherein one or more steps of advancing the first article downstream includes the step of delivering the first article to the downstream processing station.

3. A method as defined in claim 2 further comprising the step of detecting the presence of the article in the upstream and/or downstream processing stations.

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4. A method as defined in claim 1 wherein the extended upstream processing station at least partially overlaps the downstream processing station.

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5. A method as defined in claim 1 wherein the upstream and downstream stations are immediately adjacent one another, the designating step including the step of shortening the length of the downstream processing station as a result of extending the upstream processing station.

6. A method as defined in claim 1, further including the step of issuing one or more signals to an operator in the upstream processing station and issuing one or more signals to an operator in the downstream processing station, the one or more signals indicating that the upstream processing function is not complete.
- 5 7. A method as defined in claim 6 wherein the same signal is issued to both the upstream and downstream operators.
8. A method as defined in claim 6 wherein the signal is visible and/or audible by both the upstream and downstream operators.
- 10 9. A method as defined in claim 6 wherein the signal is conveyed, or encoded on a carrier signal which is conveyed, over a wired and/or wireless data link with the operator.
10. A method as defined in claim 1 wherein the extended upstream processing station is returned to its original size when the upstream processing function is either complete or when the first article is advanced downstream .
- 15 11. A method as defined in claim 1 wherein the assembly line is a vehicle assembly line.
- 20 12. A method as defined in claim 11 wherein the upstream processing station is a torque theatre.
13. A method as defined in claim 12 wherein the monitoring step includes counting the number of correct torque functions executed in the torque theatre.
- 25 14. A method as defined in claim 13 wherein the step of monitoring includes the steps of providing a torque tool and sensing the operation of the torque tool to determine when the torque tool is operating within a first set of predetermined conditions to register a correct torque function and to determine when the torque tool is operating within a second set of predetermined conditions to register an incorrect torque function.

15. A method as defined in claim 14, wherein the step of monitoring includes step of providing a map of torque targets to be hit during a predetermined torque sequence.

5 16. A method as defined in claim 15, wherein the step of monitoring includes the step of recording the location of the torque tool relative to the map, and storing the location of the torque tool and a predetermined torque condition of the torque tool at each location.

17. An assembly line, comprising:

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- an upstream processing station and a downstream processing station;

- supply means for delivering a first article to the upstream processing station;

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- at least one upstream processing device for processing the article in the upstream processing station;

- monitoring means for monitoring the upstream processing device according to an upstream processing function;

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- the monitoring means being operable to determine if the processing function has been completed;

- and if the monitoring means determines that the processing function has not been completed,

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- the monitoring means being operable to issue a signal to an operator in the upstream processing station;

- the monitoring means being operable to extend the upstream processing station to allow the operator more time to complete the upstream processing function;

- the monitoring means being operable to monitor the upstream processing function in the extended upstream processing station;

5                   - and if the monitoring means determines that the upstream processing function on the first article is still not complete, the monitoring means being operable to cause a label to be associated with the first article for downstream remedial attention.

18.    An assembly line, comprising:

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- a first processing station and a second processing station;

- conveyor means for conveying a plurality of articles along the assembly line and through at least one of the processing stations;

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- at least one first processing device for processing an article delivered to the first processing station;

- first process monitoring means for monitoring the first processing device according to a first processing function;

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- at least one second processing device for processing an article delivered to the second processing station;

- second process monitoring means for monitoring the second processing device according to a second processing function;

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- master monitoring means, communicating with each of the first and second process monitoring means for monitoring the assembly line;

- each of the first and second process monitoring means being operable to determine if the corresponding first and second processing functions have been completed; and if the either process monitoring means determines that the corresponding first or second processing function has not been completed, the corresponding monitoring means is operable to issue a signal to an operator in the corresponding processing station that the corresponding processing function is not complete;

- and where either processing function is not complete, the corresponding monitoring means being operable to extend the length of the corresponding processing station to form an extended processing station for the operator to complete the corresponding processing function;

- the corresponding monitoring means being operable to monitor the processing function in the extended processing station; and if the corresponding monitoring means determines that the processing function on the first article in the extended processing station is still not complete; then the monitoring means being operable to cause a label to be associated with the corresponding article for remedial attention.

19. A method of controlling an assembly line, comprising:

- a step for providing an article assembly line;

- a step for designating, on the assembly line, an upstream processing station and a downstream processing station;

- a step for delivering a first article to the upstream processing station;

- a step for monitoring an upstream processing function on the first article within the upstream processing station;

- and if the upstream processing function in the upstream processing station on a first article is not complete:

5                   - a step for issuing a signal to an operator in the upstream processing station that the upstream processing function on the first article is not complete;

- a step for extending the length of the upstream processing station to allow the upstream operator more time to complete the upstream processing function;

10               - a step for monitoring the upstream processing function in the extended upstream processing station;

- and if the upstream processing function on the first article in the extended upstream processing station is not complete;

15                   - a step for associating a label with the first article;

- a step for advancing the first article downstream from the extended upstream processing station;

20               - a step for advancing a second article to the upstream processing station for the upstream processing function;

- and if the upstream processing function on the first article is complete;

25                   - a step for advancing the first article downstream from the extended upstream processing station;

- a step for advancing a second article to the upstream processing station for the upstream processing function.

20. A method of monitoring the productivity of an operator in a processing station in an assembly line,  
5 comprising the steps of:

- providing an article assembly line;

10 - designating, on the assembly line, an upstream processing station and a downstream processing station;

- delivering a first article to the upstream processing station;

15 - monitoring an upstream processing function by an operator in the upstream processing station on the first article;

- and if, following a predetermined condition, the operator has not completed the upstream processing function on the first article:

20 - issuing a signal to an operator in the upstream processing station; and

- extending the length of the upstream processing station to allow the upstream operator more time to complete the upstream processing function;

25 - monitoring the upstream processing function in the extended upstream processing station;

- and if, after another predetermined condition, the operator still has not completed the upstream processing function on the first article;



- identifying the first article for remedial attention;

- advancing the first article downstream from the extended upstream processing station;

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- advancing a second article to the upstream processing station;

- and if the upstream processing function on the first article is complete;

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- advancing the first article downstream from the upstream processing station or the extended upstream processing station;

- advancing a second article to the upstream processing station; and

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- recording an incomplete upstream processing function event or a complete upstream processing function event.

21. A method of controlling an assembly line, comprising the steps of:

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- providing an article assembly line;

- designating, on the assembly line, a first processing station and a second processing station;

- delivering a first article to the first processing station;

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- monitoring a first processing function on the first article within the first processing station;

- and if the first processing function is not complete:

- issuing a signal to an operator in the first processing station that the first processing function is not complete;

- extending the length of the first processing station to allow the operator more time to complete the first processing function;

- monitoring the first processing function in the extended first processing station;

- and if the first processing function is not complete;

- associating a label with the first article for remedial attention;

- advancing the first article from the extended first processing station;

- advancing a second article to the first processing station;

- and if the first processing function is complete;

- advancing the first article from the first processing station or the extended first processing station; and

- advancing a second article to the first processing station.

22. A method as defined in claim 21 wherein the second processing station is downstream from the first processing station.

23. A method as defined in claim 21 wherein the assembly line is operable to travel along a flow path a predetermined direction.

24. A method as defined in claim 21 wherein the assembly line is operable to travel along a flow path in more than one predetermined direction.

25. An assembly line, comprising:

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- a first processing station and a second processing station;

- supply means for delivering a first article to the first processing station;

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- at least one first processing device for processing the first article in the first processing station;

- monitoring means for monitoring the first processing device according to a first processing function;

- the monitoring means being operable to determine if the first processing function has been completed;

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- and if the monitoring means determines that the first processing function has not been completed,

- the monitoring means being operable to issue a signal to an operator in the first processing station;

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- the monitoring means being operable to extend the first processing station to allow the operator more time to complete the first processing function;

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- the monitoring means being operable to monitor the first processing function in the extended first processing station;

- and if the monitoring means determines that the first processing function is still not

complete, the monitoring means being operable to cause a label to be associated with the first article for remedial attention.

26. A method as defined in claim 25 wherein the second processing station is downstream from the first processing station.
27. A method as defined in claim 25 wherein the assembly line is operable to travel along a flow path in a predetermined direction.
28. A method as defined in claim 25 wherein the assembly line is operable to travel along a flow path in more than one predetermined direction.